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APR 22 1994

April 22, 1994

FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF SECRETARY

William F. Caton  
Acting Secretary  
Federal Communications Commission  
Room 222  
1919 M Street, N.W.  
Washington D.C. 20054

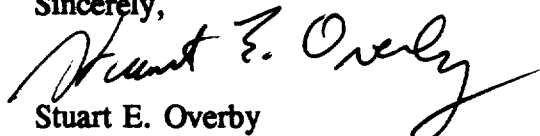
In Re: **Ex Parte Presentation in Gen Docket No. 90-314 (Amendment  
of the Commission's Rules to Establish New Personal  
Communications Services)**

Dear Mr. Caton:

On April 21, 1994, Jerry Leonard and Tom D'Amico of Motorola Inc., Terry Sterkle of AT&T, and Ron Cross and Ihor Nakonecznyj of Northern Telecom met with Julius Knapp, Bruce Franca, Phil Inglis and other representatives from the Office of Engineering and Technology to discuss technical issues surrounding unlicensed PCS services. The attached handout was provided to the staff and should be associated with Gen. Docket No. 90-314.

Please call me at (202) 371-6940 should you have any questions on this matter.

Sincerely,



Stuart E. Overby  
Manager, Regulatory Programs  
Motorola, Inc.

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**FCC MEETING 4/21/94**

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## **AGENDA**

**APR 22 1994**

**FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF SECRETARY**

- **SUMMARY**
- **WINFORUM SPECTRUM SHARING PRINCIPLES**
- **PROVIDING FOR FREQUENCY REUSE**
- **ADJACENT GEOGRAPHIC AREA ANALYSIS**
- **RECOMMENDATIONS**



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## **SUMMARY**

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### **WHY 1.25 MHZ CHANNELS?**

- **WINForum Sharing Principles for Isochronous Sub-band Require Many Narrow Channels for Spectrum Sharing**
  - **1.25 MHz Provides Sufficient Number of Servers Per Channel and Suitable Number of Channels for Reuse**
- **Limiting Spectrum Occupancy of Each Cell is Necessary to Provide for Frequency Reuse Between Different Cells and/or Systems and to Promote Fair Access to the Spectrum within a Co-Located Geographic Area.**



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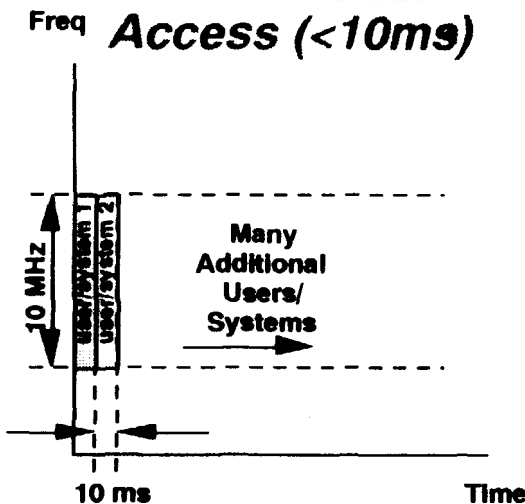


# WINFORUM SPECTRUM SHARING PRINCIPLES

## Asynchronous Devices



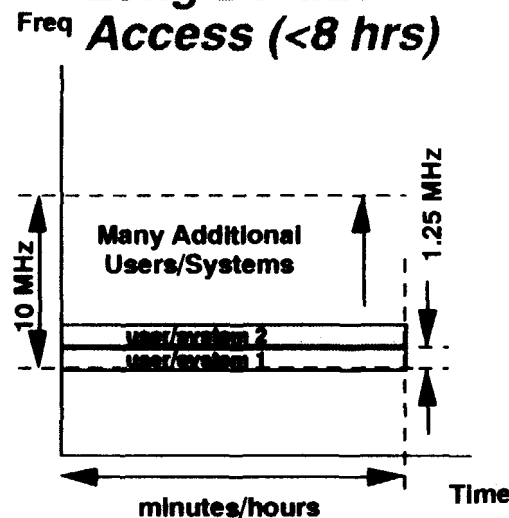
**Few Channels/  
Wide BW X  
Short Duration  
Access (<10ms)**



## Isochronous Devices



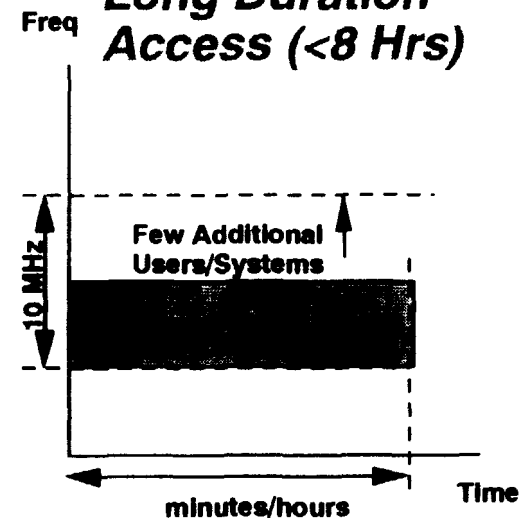
**Many Channels/  
Narrow BW X  
Long Duration  
Access (<8 hrs)**



## Incompatible Combination



**Few Channels/  
Wide BW X  
Long Duration  
Access (<8 Hrs)**



**Isochronous Devices Require Long Duration Access =>  
Many Channels of Narrow Bandwidth**



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## **WINFORUM SPECTRUM SHARING PRINCIPLES**

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### **Rationale for 1.25 MHz Channels**

*Source is ex parte presentation, January 11, 1993 by six companies from the WINTech Committee reporting on the isochronous spectrum requirements.*

- **The cell size typically achieved in buildings with the power levels specified in the Etiquette and Part 15, Subpart D rules:**
  - 50 to 75 foot radius
- **Area per user based on industry averages:**
  - 185 sq. ft. per user
- **Use of spectrum per user based on current office telephone traffic:**
  - 0.2 Erlangs per user (or approx. 12 minutes per hour)
- **Amount of spectrum per duplex channel based on audio signals using high quality, low delay, and cost effective technology (32 kbps ADPCM)**
  - 100 kHz per duplex channel



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## **WINFORUM SPECTRUM SHARING PRINCIPLES**

### **Rationale for 1.25 MHz Channels**

- Area of cell is  $2.6 \times 50 \times 50 = 6500$  sq ft.
- Number of users per cell is  $6500 / 185 \approx 35$
- Number of Erlangs of traffic per cell is  $35 \times 0.2 = 7.0$
- Blocking = 0.5% (typical office level)
- Number of servers (100 kHz channels) needed = 15
- At 100 kHz per duplex voice channel, this results in 1.5 MHz per cell to support traffic at 100% penetration.
- 1.5 MHz does not divide evenly into 10 or 20 MHz, so choose 1.25 MHz channels, given that a maximum number of different manufacturer's devices must be supported and number of sq. ft. per user is variable.
- The 1.25 MHz channelization recommended by WINForum is based on the above rationale. This allows an 8 cell reuse pattern in 10 MHz and 16 in 20 MHz

**1.25 MHz Provides Sufficient Number of Servers Per Channel  
and a Suitable Number of Channels for Reuse**



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## **WINFORUM SPECTRUM SHARING PRINCIPLES**

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### **Summary of WINForum Principles for Isochronous Sub-band:**

- **Isochronous Devices Require Long Duration Access**
- **Fundamental Mechanism for Spectrum Sharing for Different Isochronous Devices is Use of Different Frequencies**
- **Isochronous Sub-Band Requires a Large Pool of Channels for Equitable Spectrum Sharing**
- **1.25 MHz Provides Sufficient Number of Servers Per Channel and Suitable Number of Channels for Reuse**



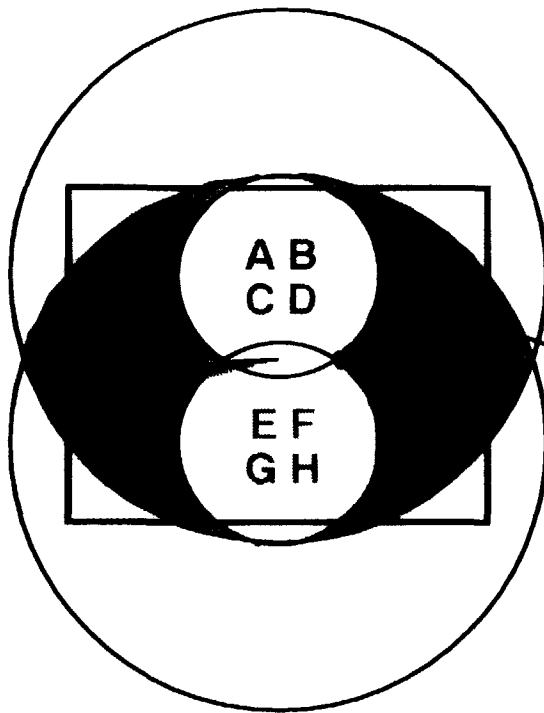
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## SHARING ANALYSIS - Providing for Frequency Reuse

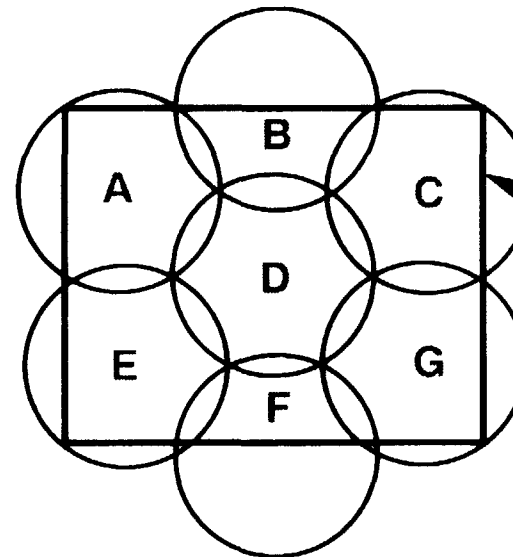
### Top View of Building - nth Floor

Each Cell Utilizing 5 MHz  
of Spectrum



Co-located  
Geographic  
Area without  
Spectrum  
Available for  
Other  
Cells/Systems

Each Cell Utilizing  
 $\leq 1.25$  MHz of Spectrum



All Co-located  
Geographic  
Areas have  
Spectrum  
Available

**Limit Spectrum Occupancy of Each Cell to Provide for Frequency Reuse Between Different Cells and/or Systems and to Promote Fair Access to the Spectrum within a Co-Located Geographic Area.**



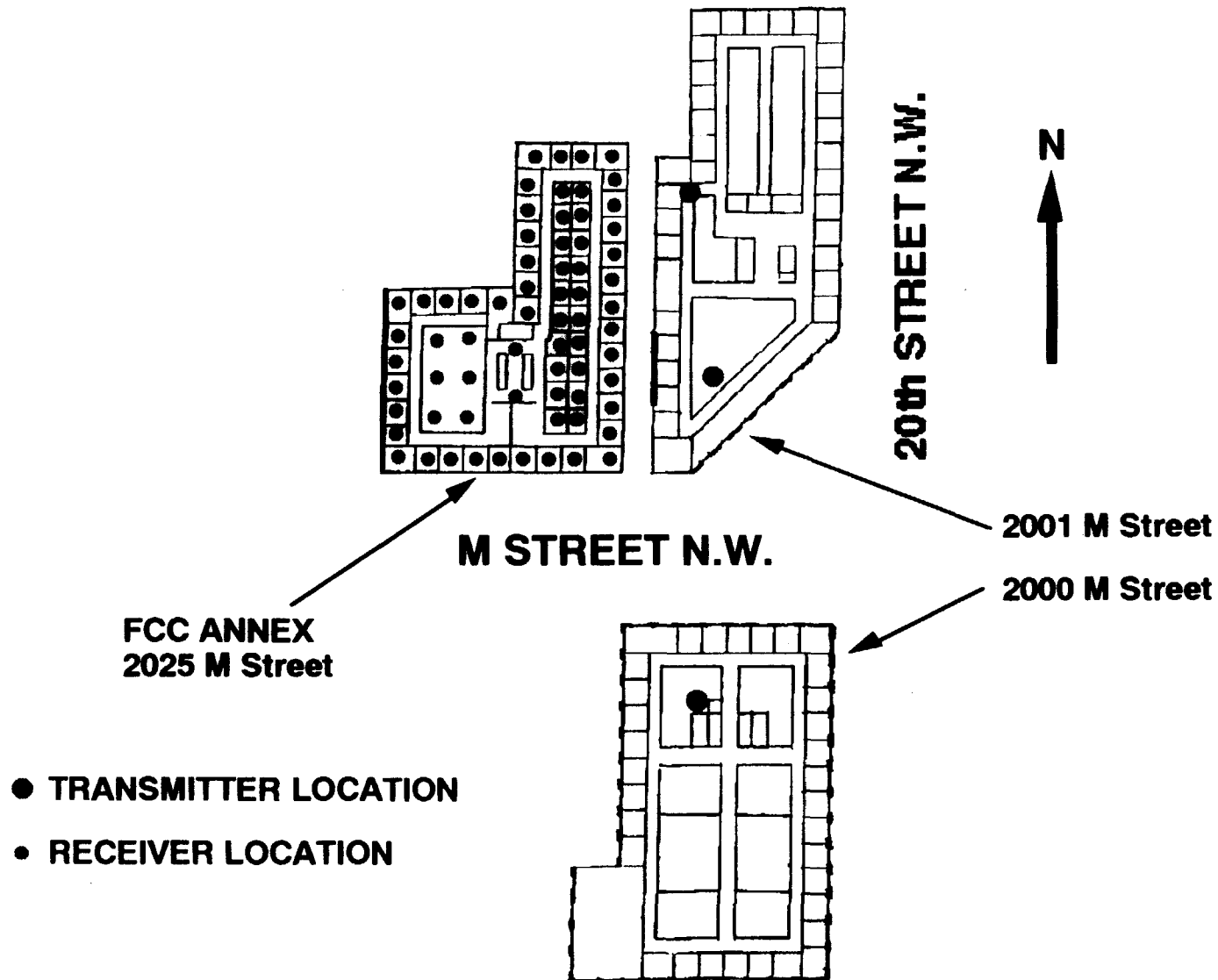
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## ADJACENT AREA ANALYSIS EXAMPLE - FCC ANNEX



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telocom

## **ADJACENT AREA PROPAGATION MODEL**

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- **Propagation modeling performed by Prof. H. Bertoni, Head of Electrical Engineering Department, Polytechnic University, NY**
- **Building footprints and locations taken from detailed maps; Photographs of buildings utilized to accurately model exterior walls and windows**
- **Typical office layout utilized for building interiors, totaling 193 rooms and 375 wall segments**
- **70 receiver locations distributed throughout one floor of FCC annex building at 2025 M. Street; 3 transmitter locations on same floor selected in nearby buildings.**
- **Reflection and transmission coefficients of each class of wall (glass, masonry, and sheet rock) were computed at 1.9 GHz**
- **Program launches rays every 0.5 degree from source and traces them through up to 13 transmissions and/or reflections to compute path loss from the sum of ray powers.**



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## **PROPAGATION LOSS BETWEEN ADJACENT DEVICES**

- **500 KHz Bandwidth Utilized For Transmitters and Receivers**
- **Maximum Transmit Power = 70.71 mW or 18.5 dBm**
- **Maximum Antenna Gain = 0 dBi**
- **Thermal Noise Power = -174 dBm + 57 dB = -117 dBm**
- **Monitoring Threshold Using Lowest Power Channel Rule  
= 117 dBm + 50 dB = -67 dBm**
- **Propagation Loss Required Between Transmitter and Receiver  
= 18.5 - (-67) = 85.5 dB**

**PROPAGATION LOSS BETWEEN THE DEVICES MUST BE  
GREATER THAN 85.5 DB FOR ANOTHER SYSTEM/DEVICE  
TO ACCESS SAME FREQUENCY**



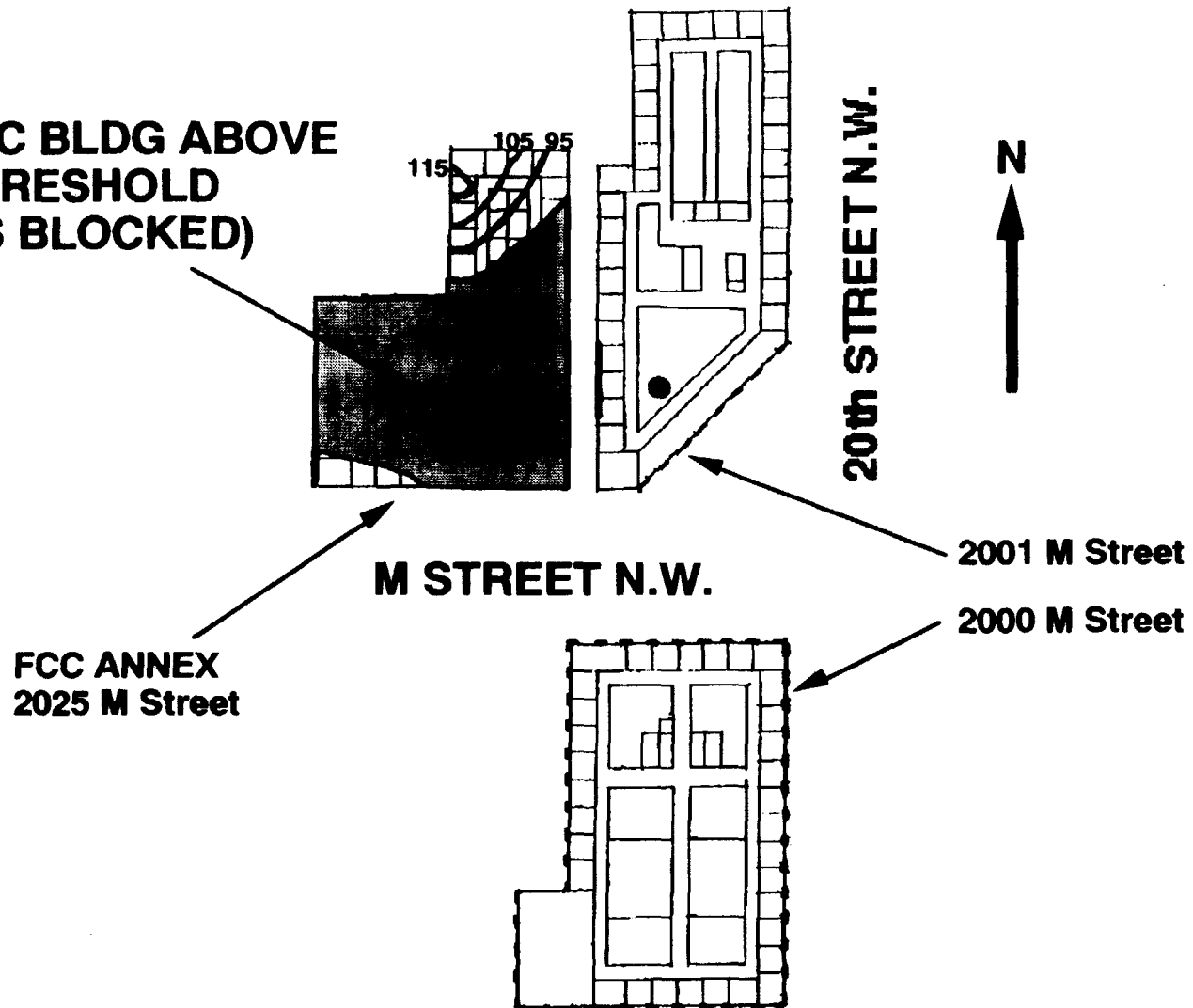
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## **ADJACENT AREA - TRANSMITTER #1**

**AREA OF FCC BLDG ABOVE  
LBT THRESHOLD  
(ACCESS BLOCKED)**



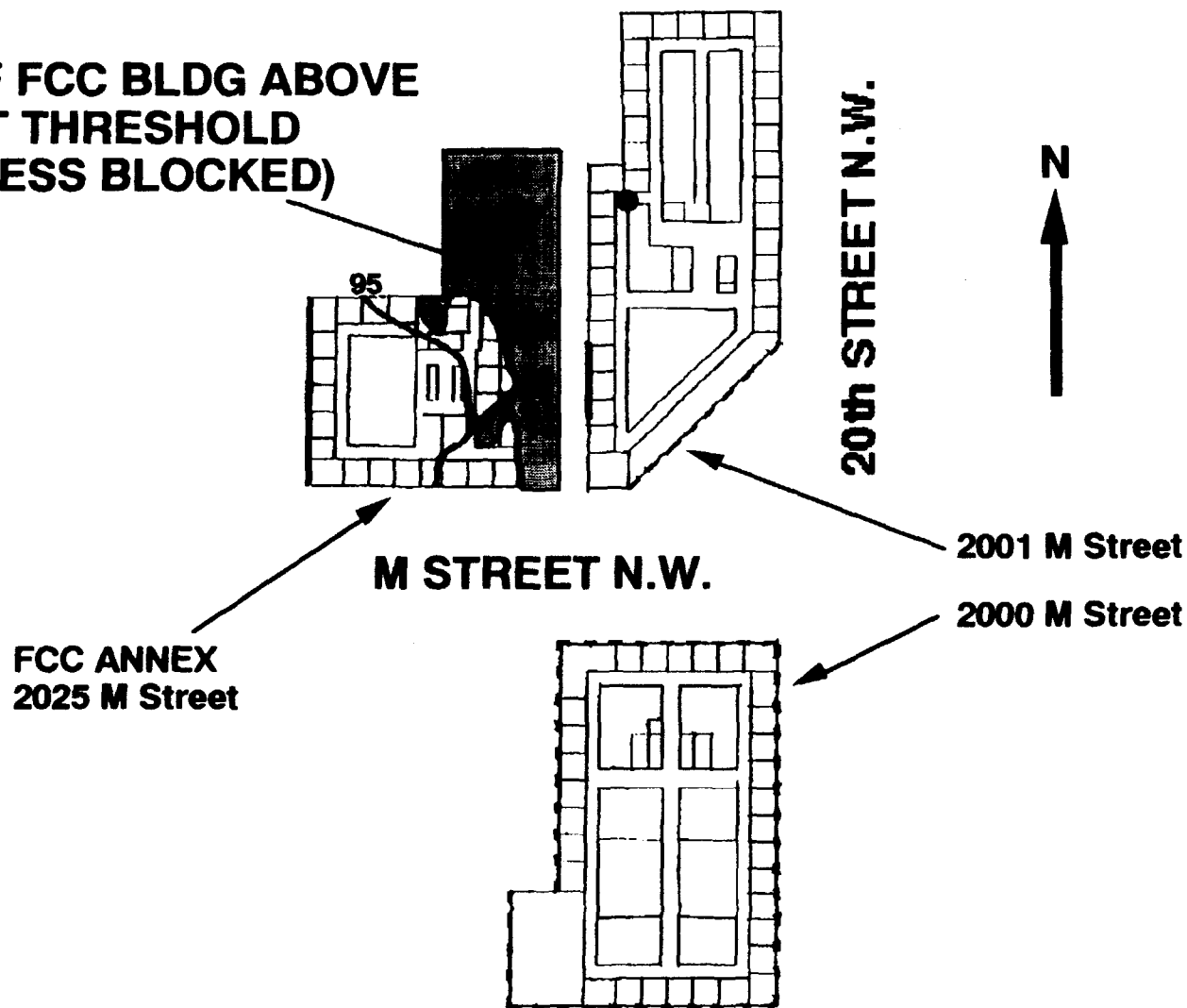
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## **ADJACENT AREA - TRANSMITTER #2**

**AREA OF FCC BLDG ABOVE  
LBT THRESHOLD  
(ACCESS BLOCKED)**



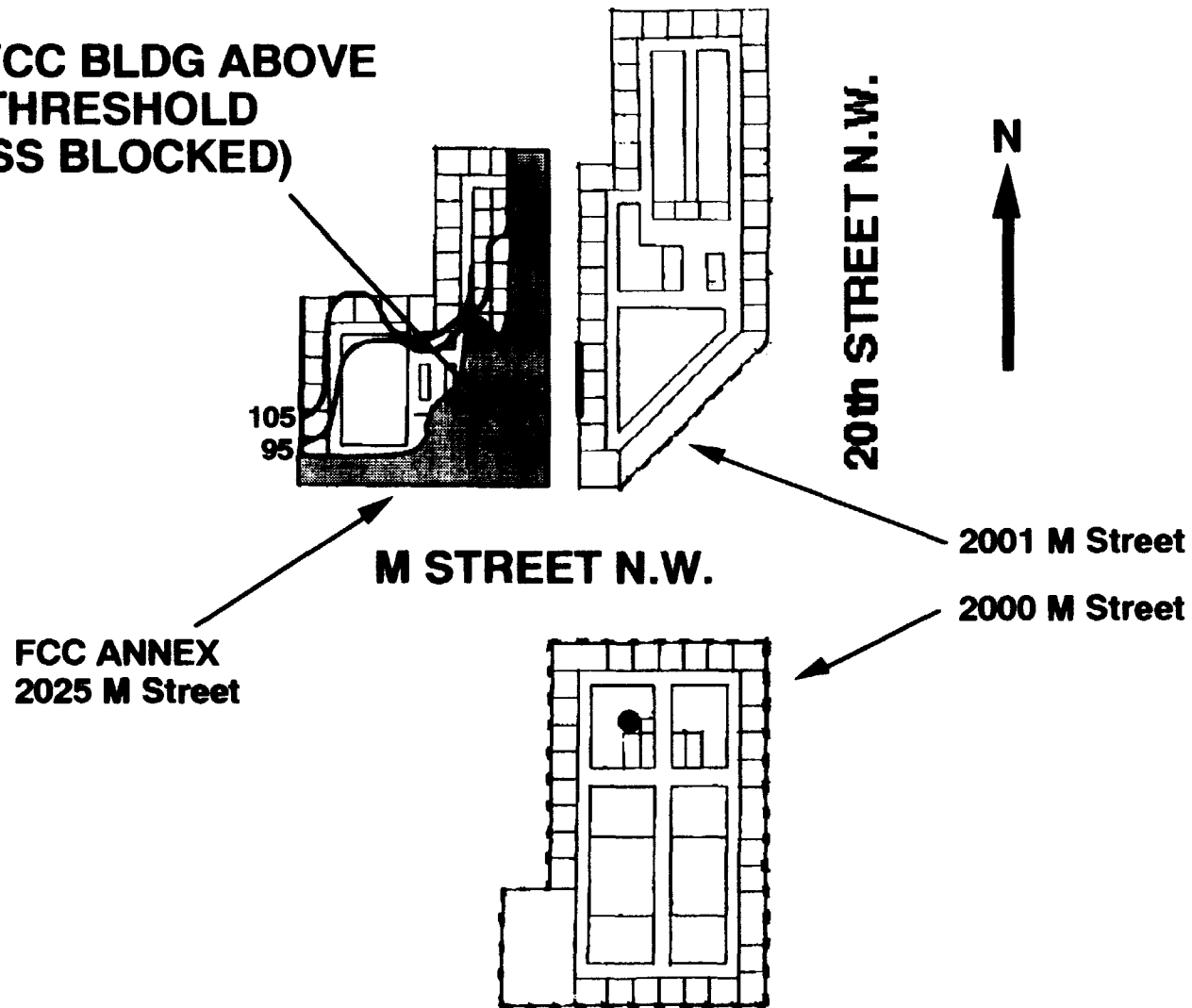
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## **ADJACENT AREA - TRANSMITTER #3**

**AREA OF FCC BLDG ABOVE  
LBT THRESHOLD  
(ACCESS BLOCKED)**



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## **RECOMMENDATIONS**

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- **Maintain the 1.25 MHz Channels in the 1920 to 1930 MHz Sub-band.**
- **Change the Channelization of the 1890 to 1900 MHz Sub-band from 5 MHz Channels to the *Originally Proposed* 1.25 MHz Channels.**

### **Justifications:**

- (1) WINForum Sharing Principles for Isochronous Sub-band Require Many Narrow Channels for Spectrum Sharing**
  - 1.25 MHz Bandwidth Channels Provide Sufficient Number of Servers per Channel and a Suitable Number of Channels for Reuse.**
- (2) Limiting Spectrum Occupancy of Each Cell is Necessary to Provide for Frequency Reuse Between Different Cells and/or Systems and to Promote Fair Access to the Spectrum within a Co-located Geographic Area**



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